

REVISION OF SOME LOWER CRETACEOUS MICROSPORES FROM BELGIUM

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ABSTRACT. Most of the new Wealden spore species described in 1955 by Delcourt and Sprumont are refigured; some have been placed in different genera. Two infra-specific taxa in the genus *Concavissimisporites* have been raised to specific rank. The diagnoses of the genera *Biretisporites*, *Concavissimisporites*, and *Aequitriradites* have been emended.

MANY of the spore species described by Delcourt and Sprumont (1955) in their pioneer work on the Belgian Wealden have subsequently been widely reported from Lower Cretaceous strata. Some of them are type species of important Mesozoic form-genera of wide distribution, and a clearer understanding of them is obviously of great importance. We have therefore re-examined the type specimens of those species instituted in 1955 and in 1959 (French Wealden) which need clarification. As a result of our investigation several species are transferred to different genera and some genera are emended; two infra-specific taxa are raised to specific rank, as we consider that subdivisions of form species of virtually unknown affinities are inappropriate. All the spores are now discussed in the order in which the various groups are treated by Potonié (1956, 1958, 1960).

We have faced considerable nomenclatural difficulty over the current Russian policy (Bolkhovitina 1961, Samoilovitch *et al.* 1961, and others) of placing large numbers of fossil dispersed spore species in Recent (extant) genera. The tangle of names in microfossil nomenclature is unfortunately unavoidable in a subject developing so quickly in several different continents, but this particular (Russian) solution seems to be totally undesirable. Knowledge of Mesozoic plants can only be obtained by studying *all* the fossils patiently; no advantage accrues from implying on very slender evidence that such genera as *Lygodium* Swartz and *Anemia* Swartz were present in the Lower Cretaceous. Search is being made continuously for the ancestors of these genera, but the circumscription of *Lygodium* Swartz cannot be blindly and indefinitely extended into the past on the basis of dispersed spores alone, without making the Recent taxon meaningless. We therefore intend to continue using and improving the generally recognized fossil spore taxa. We also notice that there has recently been conflict within the U.S.S.R. on this subject, in the two contrasted papers in the same volume by Zauer *et al.* (1960) and Zaklinskaya *et al.* (1960).

Some of the new photographs are oriented in the same way as the originals, but this is not always possible because some of the originals are 'mirror images' due to reversal in photographic printing. Some slight technical faults in a few of the new photographs are noted in the plate legends. A few of the type slides have deteriorated badly and this is noted in the worst cases. All the preparations remain in the collection of M. Delcourt at Ath, Belgium.

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SYSTEMATIC SECTION

Anteturma SPORITES H. Potonié 1893

Turma TRILETES Reinsch 1881, emend. Potonié and Kremp 1954

Subturma AZONOTRILETES Lubert 1935

Infraturma LAEVIGATI Bennie and Kidston, emend. Potonié 1956

Genus CYATHIDITES Couper 1953

Type species. Cyathidites australis Couper 1953.

Discussion. The slight extension of the genus by inclusion of further species makes it a more purely morphographic unit, and less dependent on the affinities implied by Couper (1953, 1958). Following the emendation of Delcourt and Sprumont (1955) *Concavisporites* Pflug is retained for smooth spores having a concave amb and proximal 'kyrtomes'. In uncompressed spores the kyrtomes constitute an abruptly convex exine area surrounding the laesurae; in compressed spores it is reduced to arcuate folds in the proximal inter-radial regions (Potonié and Kremp 1955, p. 13; Klaus 1960, p. 122). Few Lower Cretaceous spores attributed to *Concavisporites* exhibit kyrtomes around the laesurae.

Comparison. *Deltoidospora* has straight sides (Potonié 1956). From the Palaeozoic, *Leio-triletes* (convexly triangular amb) was validated in 1954 (Potonié and Kremp).

Cyathidites punctatus (Delcourt and Sprumont) comb. nov.

Plate 42, figs. 1–4

1955 *Concavisporites punctatus* Del. and Spr., p. 25, pl. 1, fig. 8; pl. 2, fig. 2.1955 *Concavisporites baldurnensis* Del. and Spr., p. 24, pl. 1, figs. 7 a, b.1955 *Cingulatisporites cavus* Del. and Spr. p. 38, fig. 8.1961 *Lygodium asper* (Bolk.) Bolkhovitina (pars), p. 86.

Description. The equatorially tapering 'laesurate lips' are narrow oblique exposures of the slightly thickened exine adjoining the laesurae; undehisced (or uncompressed) spores do not show this 'feature', which is elucidated by Van Campo (1961, figs. 3–8). As mentioned by Couper (1958), the wall 'has a rather undulose appearance and is not punctate'; the species (holotype—Pl. 42, fig. 3) can therefore be included in *Cyathidites*, which is described as psilate.

Discussion. The species *baldurnensis* included uncompressed (or inflated) specimens (Pl. 42, figs. 1–2) of *punctatus*, the latter being the name selected by us for retention (Art. 57 of Code of Botanical Nomenclature, 1961—Montreal). The holotype of the species *cavus* is a specimen of *punctatus* with much adherent mineral matter (Pl. 42, fig. 4). The Canadian spore figured by Pocock (1962) as *C. punctatus* may be distinct in possessing a sculpture of 'distinct granules'.

Genus BIRETISPORITES Delcourt and Sprumont 1955, emend.

1955 *Biretisporites* Del. and Spr., p. 40.1955 *Punctatisporites* Ibrahim, emend. Del. and Spr. (pars), p. 29.1957 *Hymenophyllumsporites* Rouse, p. 363.

Emended diagnosis. Microspores trilete with a triangular to subtriangular amb. Laesurae enclosed within elevated lips which are upturned extensions of the proximal exine. Exine smooth or almost smooth.

Type species. *B. potoniaei* Del. and Spr. 1955.

Comparison. The type species was originally considered to have equatorial thickenings (Del. and Spr. 1955, Potonié 1956). The holotype, however, has no more than a smooth, uniformly thick exine and a trilete aperture enclosed within elevated lips. *Biretisporites* is therefore synonymous with *Hymenophyllumsporites*, which was instituted and clearly defined by Rouse (1957). It is distinct from *Dictyophyllidites* Couper, the exine of which is thickened about the laesurate margins ('margo' of Couper 1958). The type species of *Psilatrilletes* van der Hammen ex Potonié resembles *Biretisporites*, but its diagnosis does not mention elevated laesurate lips.

Biretisporites potoniaei Delcourt and Sprumont 1955

Plate 42, figs. 12–14; Plate 44, fig. 11

1955 *Biretisporites potoniaei* Del. and Spr., p. 40, fig. 10.

1955 *Punctatisporites pileolus* Del. and Spr., p. 30, pl. 2, fig. 5.

1955 *Punctatisporites nidosus* Del. and Spr., p. 31, fig. 4 (cf. Kremp, W. 1958, *Catalogue of fossil spores and pollen*, 4, 17).

1956 *Psilatrilletes pileolus* (Del. and Spr.) Potonié, p. 15.

Holotype. Delcourt and Sprumont 1955, p. 40, fig. 10; here refigured on Plate 42, figs. 12, 13. Distal oblique aspect.

Description. Microspore trilete, biconvex; amb convexly subtriangular, diameter 48μ . Laesurae 23μ long; lips narrow ($1\text{--}2\mu$ wide), elevated ($2\text{--}3\mu$ high) extensions of the proximal exine. Exine smooth, $2\cdot5\mu$ thick. The specimen has a median fold in the distal exine, as does another specimen shown on Plate 44, fig. 11.

Discussion. The further specimens of *Psilatrilletes* (al. *Punctatisporites*) *pileolus* (Del. and Spr. 1959, pl. 5, fig. 15) are here refigured on Plate 42, fig. 14; they conform to the above description of *potoniaei* as does the designated holotype of *pileolus* on which the apparent granules are mineral grains.

Infraturma APICULATI Bennie and Kidston, emend. Potonié 1956

Genus CONCAVISSIMISPORITES Delcourt and Sprumont, emend.

1955 *Concavissimisporites* Del. and Spr., p. 25.

1961 *Lygodium* Swartz; Bolkhovitina (pars), p. 100.

1961 *Lygodium* Swartz; Ivanova (pars) in Samoilovitch *et al.*, p. 90.

1962 *Concavisporites* Pflug; Pocock (pars), p. 46.

Emended diagnosis. Microspores trilete; amb triangular with concave to almost straight sides. Exine of uniform thickness (inclusive of sculpture), verrucate; verrucae more or less uniformly developed and evenly distributed over entire spore surface.

Type species. *C. verrucosus* Del. and Spr., emend.

Discussion. The genus was originally instituted to include trilete, azonate microspores

characterized by a 'concavissime' amb. Potonié (1956) suggested, but did not formally propose, that the genus should be restricted to contain only such spores with verrucate sculpture. The genus is here formally restricted to include verrucate spores which have concave, but not necessarily strongly concave, amb; it is distinct from *Trilobosporites* Pant ex Potonié, which has a differentially thickened exine and/or larger sculptural elements about the radial regions at the equator.

Concavissimisporites verrucosus Delcourt and Sprumont 1955, emend.

Plate 42, figs. 5–7

1955 *C. verrucosus* forma *verrucosus* Del. and Spr., p. 25, pl. 2, fig. 1a.

1961 *Lygodium verrucosus* (Del. and Spr.) Bolkhovitina, p. 100, pl. 37, figs. 2a, b.

non 1955 *C. verrucosus* f. *crassatus* Del. and Spr., p. 26.

non 1962 *Concavisporites verrucosus* (Del. and Spr.) Pocock, p. 46.

non 1962 *Concavisporites verrucosus* var. *minor* Pocock, p. 47.

Holotype. Delcourt and Sprumont 1955, p. 25, pl. 2, fig. 1a, here refigured on Plate 42, figs. 5–7. Proximal aspect.

Description. Amb 90μ in diameter (60μ in maximum radial length), triangular with concave sides and broadly rounded angles. Laesurae 43μ long ($2/3$ spore radius), straight, and with linearly arranged verrucae along margins. Exine 3.5μ thick (inclusive of sculpture); verrucae closely spaced, $1\text{--}2\mu$ high, semicircular in optical section, and with circular to polygonal bases $2\text{--}4\mu$ in diameter.

Comparison. This specimen is considered specifically distinct from the holotypes of the two validly designated infra-specific taxa, f. *crassatus* and var. *minor*, which are (below) elevated to specific rank.

Discussion. *C. verrucosus* is distinct from spores assigned to *Concavisporites variverrucatus* by Couper (1958, p. 142, pl. 2, figs. 4–5); it is considerably larger, more strongly concave, and has more regular verrucae.

Concavissimisporites crassatus (Del. and Spr.) sp. nov.

Plate 42, figs. 9–11

1955 *C. verrucosus* f. *crassatus* Del. and Spr., p. 26, pl. 2, fig. 1b.

non 1962 *Concavisporites verrucosus* (Del. and Spr.) Pocock, p. 46.

Holotype. Delcourt and Sprumont 1955, pl. 2, fig. 1b, here refigured on Plate 42, figs. 9–11. Proximal aspect.

Description. Amb triangular with rounded angles and concave sides, 78μ in diameter (50μ in maximum radial length). Laesurae 43μ long ($4/5$ spore radius), straight; margins obliquely exposed and with linearly arranged verrucae. Exine 3μ thick (including sculpture); with low, dome-shaped verrucae which are $1\text{--}3\mu$ in basal diameter and spaced $1\text{--}3\mu$ apart.

Comparison. The species differs from *C. verrucosus* in having smaller and more widely spaced verrucae and longer laesurae.

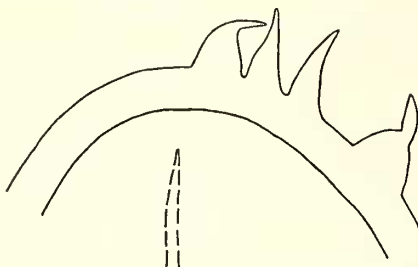
Concavissimisporites minor (Pocock) sp. nov., comb. nov.1962 *Concavisporites verrucosus* var. *minor* Pocock, p. 47, pl. 5, fig. 75.

Discussion. The imperfectly preserved holotype is distinct from *C. verrucosus* and *C. crassatus* in having smaller verrucae which are more widely spaced.

Genus *PILOSISPORITES* Delcourt and Sprumont 1955*Pilosisorites verus* Delcourt and Sprumont 1955

Text-fig. 1

Comparison. Text-fig. 1 shows the broad-based form of the sculptural elements of the holotype. The other difference from *P. trichopapillosus* is in the close spacing of sculptural elements in the equatorial radial regions.



TEXT-FIG. 1. Detail of sculpture of *Pilosisorites verus*, holotype (Del. and Spr. 1955, pl. 4, fig. 1). $\times 1000$.

Infraturma MURORNATI Potonié and Kremp 1954

Genus *LYCOPIDIUMSPORITES* Thiergart ex Delcourt and Sprumont 1955

Discussion. The genus was only validated in 1955 by selection of a 'lectogenotype', *L. agathoeus* (Potonié). Nilsson (1958, p. 45) used this genus but Krutzsch (1959, pp. 159, 164, 165) suggested that the genus should be abandoned; although we sympathize with his reasons we do not find his argument convincing. The two species mentioned below could be placed in *Khukisporites* Couper 1958, if this genus should fall.

EXPLANATION OF PLATE 42

All figures $\times 500$, unless otherwise stated.

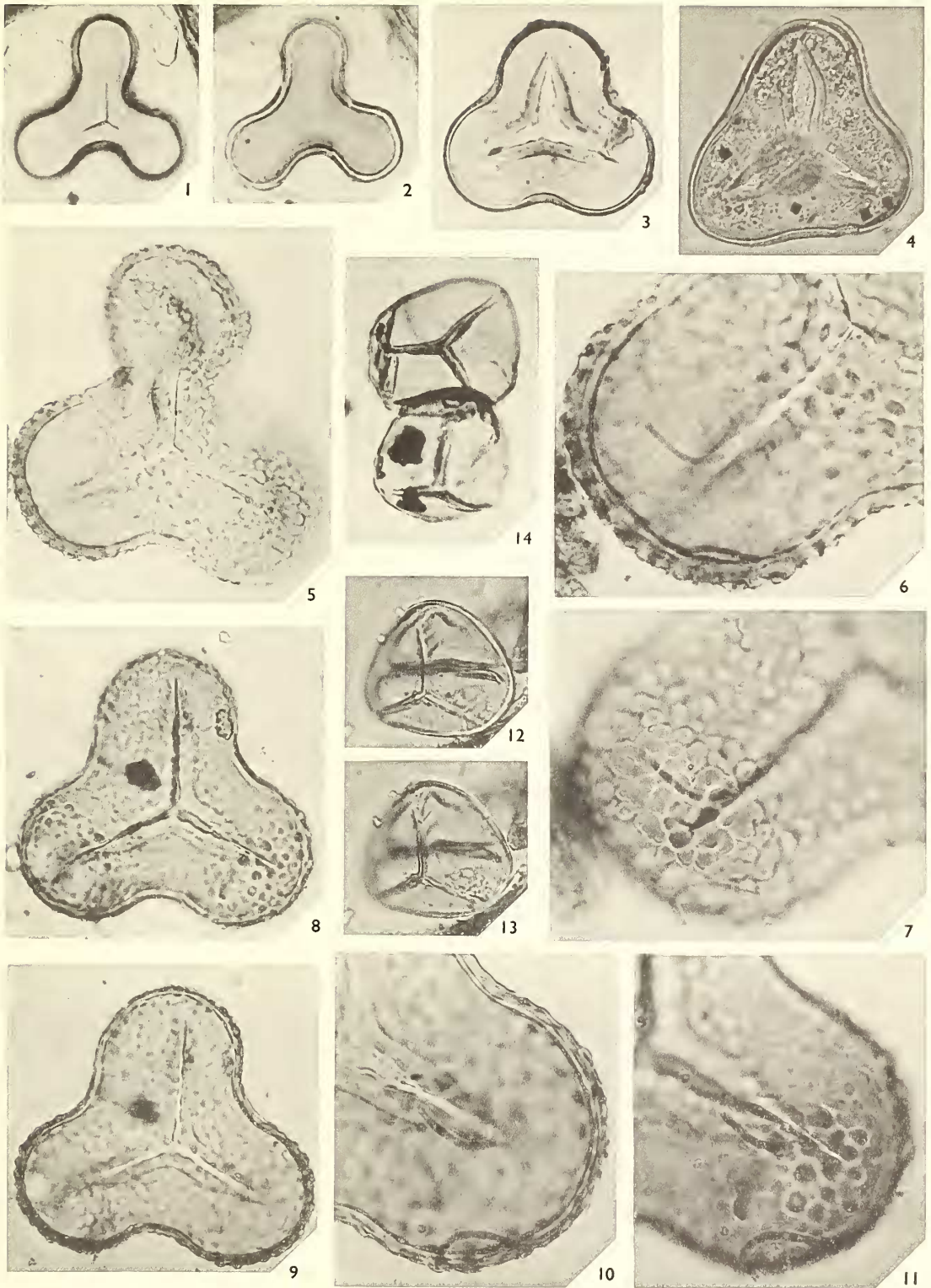
Figs. 1–4. *Cyathidites punctatus* (Del. and Spr.) comb. nov. 1–2, Distal aspect, specimen of *Concavisporites baldurnensis* D. and S. 1955, prep. ϵ ; 1, Low focus; 2, Mid focus. 3, Holotype, *Cyathidites punctatus*, optical section; aspect distal. 4, Proximal aspect of holotype of *Cingulatisporites cavus* D. and S. 1955, p. 38; optical section, air bubble subcentral.

Figs. 5–7. *Concavissimisporites verrucosus* D. and S. emend., Holotype. 5, Mid focus. 6, Detail, $\times 1000$, mid focus. 7, $\times 1000$, high focus.

Figs. 8–11. *Concavissimisporites crassatus* (D. and S.) sp. nov., holotype, proximal aspect (D. and S. 1955, pl. 2, fig. 1a). 8, High focus. 9, Mid focus. 10, Detail, $\times 1000$, mid focus. 11, $\times 1000$, high focus.

Figs. 12–14. *Biretisporites potoniaei* D. and S. 1955. 12, Holotype, oblique distal aspect; mid focus. 13, Low focus. 14, Spores illustrated as *Psilatriteles pileolus* (D. and S.) D. and S. 1959, pl. 5, fig. 15.

Note. Two extraneous hairs are present in figs. 6, 7, 10, 11.



Lycopodiumsporites triarcuatus Delcourt and Sprumont 1955

Plate 43, figs. 1, 2, 5

Description. The damaged holotype is refigured (Pl. 43, fig. 1) and supported by two other specimens from the same material (Pl. 43, figs. 2, 5). The proximal face is smooth, unsculptured; other features as previously described. The two *formae* mentioned (1955) are not validly published.

Lycopodiunsporites elongatus Delcourt and Sprumont 1955

Plate 43, figs. 3, 4

Description. The holotype is refigured. Again the proximal face is smooth, unsculptured.

Genus *CICATRICOSISPORITES* Potonić and Gelletich 1933

Type species. *C. dorogensis* Pot. and Gell.; Eocene, Hungary.

Discussion. Kedves (1961, p. 124) selected neotypes (*sic*) for *C. dorogensis*, and rediagnosed the species to exclude, among other things, the many Mesozoic references (Couper 1958, and others); he did not entirely succeed in this, but the purpose is clear and we agree that none of the illustrated Lower Cretaceous specimens conforms with the species. We therefore follow and amplify the policy of Delcourt and Sprumont (1955).

Cicatricosisporites hallei Delcourt and Sprumont 1955

Plate 43, figs. 6, 7

Description. The holotype is refigured. The muri are regular with sharply defined edges, and are flat-topped; they are twice as wide as the intervening canals (lumina). The spacing of four canals and muri in 11μ , is as previously illustrated (1955, text-fig. 1).

Comparison. *C. hallei* differs from *C. dorogensis* in possessing flat-topped muri with sharp edges.

Cicatricosisporites sewardi Delcourt and Sprumont 1955

Plate 43, fig. 8

Description. The holotype is refigured as a photograph; diameter 55μ , not as previously stated. The spacing (four canals and muri) is about 12μ only and thus differs little from *C. hallei*; the canals are, however, relatively wider, and the muri more round-topped with less sharp edges.

Cicatricosisporites mohrioides Delcourt and Sprumont 1955

Discussion. It was not possible to improve on the original figure of this species because the holotype is now orientated in a lateral aspect, and does not appear to be well preserved.

Turma ZONALES Bennie and Kidston, emend. Potonié 1956
 Subturma AURITOTRILETES Potonié and Kremp 1954
 Infraturma AURICULATI Schopf, emend. Potonié and Kremp 1954
 Genus TRILOBOSPORITES Pant ex Potonié 1956

1956 *Trilobosporites* Pant ex Potonié, p. 55.

1961 *Lygodium* Swartz; Ivanova (pars) in Samoilovitch *et al.*, p. 90.

Type species. *T. hannonicus* (Del. and Spr.) Potonié 1956.

Restated diagnosis. Microspores trilete; amb triangular. Exine differentially thickened in equatorial radial regions where sculptured valvae are developed. Sculptural elevations (grana, verrucae) larger and sometimes coalescent on valvae.

Discussion. *Trilobosporites* is distinct from *Concavissimisporites* on distribution of sculptural elements and presence of valvae. *Matonisporites* Couper has a smooth exine and *Cibotiumidites* Maljavkina is defined by Potonié (1960, p. 62) as cingulate.

Trilobosporites hannonicus (Del. and Spr.) Potonié 1956

Plate 43, figs. 9, 10

Holotype. Delcourt and Sprumont 1955, p. 24, pl. 2, fig. 3. Refigured here on Plate 43, figs. 9, 10; distal aspect.

Description. Amb concavely triangular with truncated angles, diameter 58μ . Laesurae 25μ long; margins weakly thickened and obliquely exposed. Exine 2.5μ thick, 4μ in equatorial radial regions where verrucate valvae are developed; verrucae low (c. 1μ high), closely spaced, and with circular to polygonal bases $3-4\mu$ in diameter. Remainder of exine with smaller, verrucae and granules, which are polygonal to circular in outline and $1-3\mu$ in basal diameter.

Remarks. Potonié (1956, p. 55) described the exine wrongly as microreticulate. It is now shown to be verrucate.

Trilobosporites bernissartensis (Del. and Spr.) Potonié 1956

Plate 43, figs. 11-14

Holotype. Here figured as a photograph, Plate 43, figs. 11, 12; distal aspect.

EXPLANATION OF PLATE 43

All figures $\times 500$ unless otherwise stated.

Figs. 1, 2, 5. *Lycopodiumsporites triarcuatus* D. and S. 1955. 1, Holotype, proximal aspect; mid focus.

2, Prep. B301, proximal aspect, high focus. 5, Prep. B103, distal aspect, high focus.

Figs. 3, 4. *L. elongatus* D. and S. 1955. Holotype, distal aspect. 3, Mid focus. 4, High focus.

Figs. 6, 7. *Cicatricosisporites hallei* D. and S. 1955. Holotype, oblique distal aspect. 6, $\times 1000$, high focus. 7, Mid focus.

Fig. 8. *C. sewardi* D. and S. 1955. Holotype, proximal aspect, high focus.

Figs. 9, 10. *Trilobosporites hannonicus* (D. and S. 1955). Holotype, distal aspect. 9, Low focus. 10, $\times 1000$, mid focus.

Figs. 11-14. *Trilobosporites bernissartensis* (D. and S. 1955). 11, Holotype, distal aspect, optical section. 12, High focus, proximal surface. 13, Single mount X3, Loc. Baudour Bed 1, proximal aspect, optical section. 14, Single mount X14, Loc. Baudour Bed 1, proximal aspect, mid focus.

